Fairbanks Experimental Fish Hatchery Update, Summer 2005

The Fairbanks Pilot hatchery was built to examine the suitability of using local well water supplies, heated with waste effluent from Aurora Energy, for fish culture. The goal during 2004/5 was to rear rainbow trout from 4 grams (approximately 2½ inches long) to 120 grams (approximately 9 inches long). (Fish 4 grams in size were obtained from Fort Richardson Fish Hatchery in Anchorage). Groundwater was treated with aeration and media filtration through BIRM™ manganese dioxide media. Throughout the rearing experiment, fish were periodically sampled for tissue analysis; specifically, we looked for damage to gills and abnormalities in kidneys and livers. Water used to culture fish was also periodically sampled for metals analysis.

The Experimental Fish Hatchery housed four 1-m^3 circular tanks (holding approximately 280 gallons each). One set of two tanks was configured under a flow-thru scenario, where water enters the tanks, mixes, and is then discharged out of the system. The second set of tanks was configured as a partial reuse system, where part of the discharged water was recycled back into the culture tanks. This reuse configuration was used for approximately one month, but later abandoned after equipment failure resulted in biosolids being returned back to each tank. This created a somewhat harmful environment for fish in these particular tanks, and resulted in some mortality of juvenile fish (older fish did not experience mortality under these conditions). After a month of partial reuse, the second set of tanks was reconfigured to operate under flow-thru conditions.

During 2004/5, rainbow trout reached an average weight of 188 grams (approximately 9 inches long) after 11.5 months of rearing at 4 to 9 degrees Celsius. Our largest fish reached a weight of 400 grams (12 inches long). Fish had to be periodically "thinned" or stocked out of each tank so the overall biomass density did not get too high. The original goal was to not exceed 30 kg fish/m^3 tank. However, our fish biomass densities did occasionally get as high as 58 kg/m^3.

Results from 2004/5 showed that we were able to successfully raise fish to catchable size (and beyond) using well water and the BIRM media filtration for iron removal. However, using the BIRM media for water treatment came with considerable maintenance, large volumes of water required to backwash each filter vessel, and associated costs of backwash disposal. Our system of water delivery and piping was also never designed for long-term use; i.e. no clean-outs were ever included during installation, making it nearly impossible to prevent build-up of iron deposits on pipe interiors, which eventually clogged electronic valves. To date, only aeration followed by BIRM™ media filtration[1] has been tested at the Fairbanks Experimental Hatchery. BIRM™ media filtration is used by some municipalities for iron removal from drinking water, and was recommended for use at the pilot hatchery by Golden Heart Utilities and Aurora Energy (Fairbanks, Alaska). The BIRM™ media was successful at removing iron (enabling investigators to culture fish), but required frequent backwashing of filter vessels and consumption of vast quantities of water for each backwash. Scaling up this technology to a full-scale production fish hatchery would translate to high operational costs for water treatment and fish production. Therefore, the BIRM™ media filtration, although effective, would likely be a poor candidate for iron removal from groundwater at the future Fairbanks Fish Hatchery, unless another filtration mechanism was partnered to the BIRM media to reduce backwash requirements.

Alternative technologies exist where water consumption is reduced, resulting in an overall lowering of operational costs for hatchery fish production. One such technology, the Oxycair™ system

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[1] Clack Cooperation, 4462 Duraform Lane, Windsor, Wisconsin 53598-9716 USA, Phone (608)846-3010. http://www.clackcorp.com/water/pdf/birm.pdf

(manufactured by WR3 Technologies[2]), was identified during a State-contracted study with CH2MHill for statewide fish hatchery improvements, and concept design of the Fairbanks Fish Hatchery. The Oxycair™ water treatment system "super-oxidizes" iron, manganese, and hydrogen sulfide from water, by introducing air under extreme pressure and cavitation. Oxidized components are accumulated and filtered at a fine bubble air membrane and water interface, and further removed by subsequent mixed-media filtration. This treatment method has been shown to be effective at removing contaminants (including iron) from pulp mill industry leachate (Gagnon, et. al. 2004), and has a comparatively lower backwash water volume requirement. CH2MHill estimated its operational cost to be less than $0.20 per 1,000 gallons of water treated, with only 0.5 to 1.0 percent lost to backwash requirements. The Oxycair™ system is anticipated to have both a lower capital and operational cost than other iron removal technologies common to the water treatment industry (i.e. ozonation followed by biological filtration or microfiltration, or media filtration).

Water flows at the future Fairbanks Fish Hatchery are proposed to be near 500 to 600 gallons per minute (gpm), while water flow requirements at the existing pilot hatchery are only 100 gpm. The Oxycair™ technology can be scaled as a pilot unit to match these smaller flows, allowing for experimental evaluation prior to purchase and full-scale use.

The Experimental Fish Hatchery is currently under expansion, as larger tanks (16-foot diameter with 20-m3 volume, or 5000 gallons each) and new equipment is being installed. It is anticipated that ADF&G Sport Fish will operate the Experimental Fish Hatchery for three years, during which time the future Fairbanks Fish Hatchery will be designed and constructed. The goals of operating the Experimental Fish Hatchery are to:

1) Utilize modern recirculating aquaculture technologies on a pilot scale, before they are applied to fish production on a larger scale within the future hatchery, thus mimicking fish culture conditions to be used within the newly-constructed facility. It is proposed that all catchable fish production within the future hatchery will utilize these technologies, because they require less total water use, and consequently less water treatment. This will lower the operational costs of fish production at a future hatchery. Typically, modern recirculating aquaculture facilities utilize large culture tanks (to maximize rearing volume per unit area of floor space), high fish densities, and large-scale biofiltration processes. For example, the future hatchery in Fairbanks will house up to twenty or more circular tanks that are 6-feet deep and 20- to 26-feet in diameter, with culture volumes of 40- to 60-m^3. These are to be operated as recirculating systems where water is continually recycled and reused. Literally thousands of fish will be reared within each tank. The current pilot hatchery houses laboratory-scale 5-foot diameter tanks, with a culture volume of 1 m^3 each. Expansion of the pilot hatchery will include installation of 16-diameter tanks, having culture volumes of 20-m^3. This will allow investigators to rear fish on a large-volume scale, more realistically approximating fish culture conditions within the future facility. Biofiltration to remove nitrogenous ammonia wastes from recycled water will require the operation of a bacterial-based large fluidized sand bed filter. Additionally, solids filtration, gas conditioning of hatchery water, ultraviolet sterilization, and pressurized reoxygenation processes will be utilized to operate the recirculating systems at the pilot hatchery. Operating a pilot-scale recirculating aquaculture system will serve as a training mechanism to Fairbanks Sport Fish Division staff, as the application of this technology in fish culture is new to Alaska. It will also identify any operational issues that need to be addressed and/or modified prior to actual full scale construction of a new hatchery in Fairbanks.

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[2] WR3 Technologies, Inc., 608 de la Sabliere, Bois-des-Filion (Quebec), Canada J6Z 4T7, Phone (450)-621-6678. WMI Limited

2) Utilize and evaluate the water treatment technologies for iron removal, to be applied to the future fish hatchery in Fairbanks, so that operational features can be initially learned on a pilot scale. The Oxycair™ technology for iron removal from groundwater was identified by CH2MHill in their concept design for a Fairbanks Fish Hatchery. This is a new technology within the aquaculture industry and has never been used in Alaska. ADF&G, SF intends to test the most promising technologies for iron removal, based on efficacy, water use, and costs (both capital and operational) at the pilot hatchery.

3) Transition from a simple experimental hatchery to a small-scale production hatchery, and produce catchable rainbow trout for stocking of roadside lakes within Fairbanks. This is important because SF is anticipating a drastic reduction (50% or more) of catchable rainbow trout beginning in 2005. Military-generated heated water supplies are being discontinued at Anchorage-based fish hatcheries, where all fish for lake stocking within the Interior originate from. Although there is insufficient space at the Fairbanks pilot hatchery to replace all lost catchable rainbow trout production in Anchorage, expansion of the pilot hatchery warehouse space will allow ADF&G SF staff to produce 10,000 or more catchable rainbow trout, for lake stocking. This will enable the maintenance of some local roadside fisheries which are dependent on annual introductions of catchable-sized fish, until new hatcheries are constructed within Fairbanks and Anchorage

As with studies conducted during 2004/5, investigators will culture fish under a long-term rearing scenario, and assess fish health for tissue damage or physiological abnormalities in fish, as an indicator of water quality, particularly the effectiveness of iron removal technologies.

A full report, detailing all scientific results from last season's fish culture endeavors, is under preparation and will be posted at a later date. Click on the slideshow on our home page to see more results and details from 2004/5. For inquiries, please contact:

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